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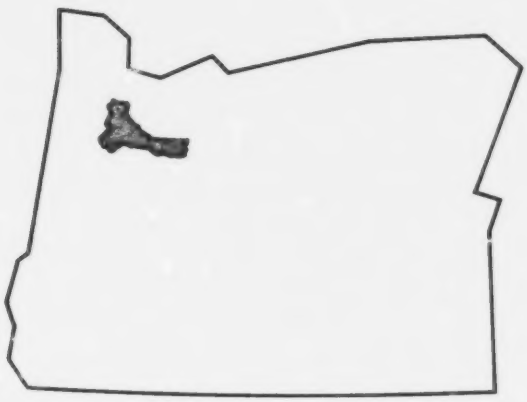
FLOOD INSURANCE STUDY

ORIGINAL

MARION COUNTY, OREGON
UNINCORPORATED AREAS

VOLUME 1 OF 2



REVISED: AUGUST 19, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 410154

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for flood plain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) report revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the unincorporated areas of Marion County, Oregon. This information will be used by Marion County to update existing flood plain regulations as part of the regular phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and flood plain development.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the initial study were performed by CH2M HILL, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-3994. The initial study was completed in October 1977.

Flood information used for the revised portion of Willamette River was taken from information used in FISs for Yamhill and Clackamas Counties, Oregon (References 1 and 2).

Flood information used for the revised portion of North Santiam River was taken from information used in the FIS for the City of Lyons (Reference 3).

Information used for flooding on the revised portions of Mill, Battle, East Fork Pringle, Middle Fork Pringle, and Powell Creeks was taken from the FIS for the City of Salem (Reference 4).

Flood information used for the revised portion of Claggett Creek was derived from the FISs for the City of Salem and the City of Keizer (References 4 and 5).

Information used for flooding on Little Bear Creek was taken from information used in the FIS for the City of Hubbard (Reference 6).

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1.3 Coordination

Areas requiring detailed and approximate study for the initial FIS were identified at a meeting in March 1976 by personnel of CH2M HILL, Inc. (the study contractor), the Federal Insurance Administration, the Oregon State Water Resources Department, and Marion County. Additional meetings were held in August 1976, attended by personnel from the study contractor and Marion County Planning and Public Works Departments, to solicit and collect background data concerning flooding in the County.

The hydraulic and/or hydrologic analyses for all areas studied in detail were coordinated with the U.S. Army Corps of Engineers (COE), Portland District. The hydrologic analyses were coordinated with the U.S. Geological Survey (USGS) office in Portland, Oregon. The U.S. Soil Conservation Service (SCS) offices in Portland and Salem, Oregon, were contacted concerning the hydraulic and hydrologic analyses in the Turner-Aumsville-Stayton area. Additional contacts were made with the Santiam Water Control District (Stayton), Mid-Willamette Valley Council of Governments (Salem), Oregon State Water Resources Department (Salem), Oregon State Highway Division (Salem), and the National Weather Service (Portland).

During the course of the work done by the study contractor, flood elevations and flood boundaries were reviewed with county officials during September 1977.

The results of the initial study were reviewed at a final community coordination meeting held on August 10, 1978. Attending the meeting were representatives of FEMA, the study contractor, and the County.

In November 1986 this FIS was revised using data from the FISs of incorporated communities within the county and the FISs of adjacent counties.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Marion County, Oregon. Not included in this study are the following incorporated cities and towns: Aumsville, Mill City, Mt. Angel, St. Paul, Salem, Scotts Mills, Silverton, Stayton, Sublimity, Turner, and Woodburn. Chemawa Indian School was also not included. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through November 1991.

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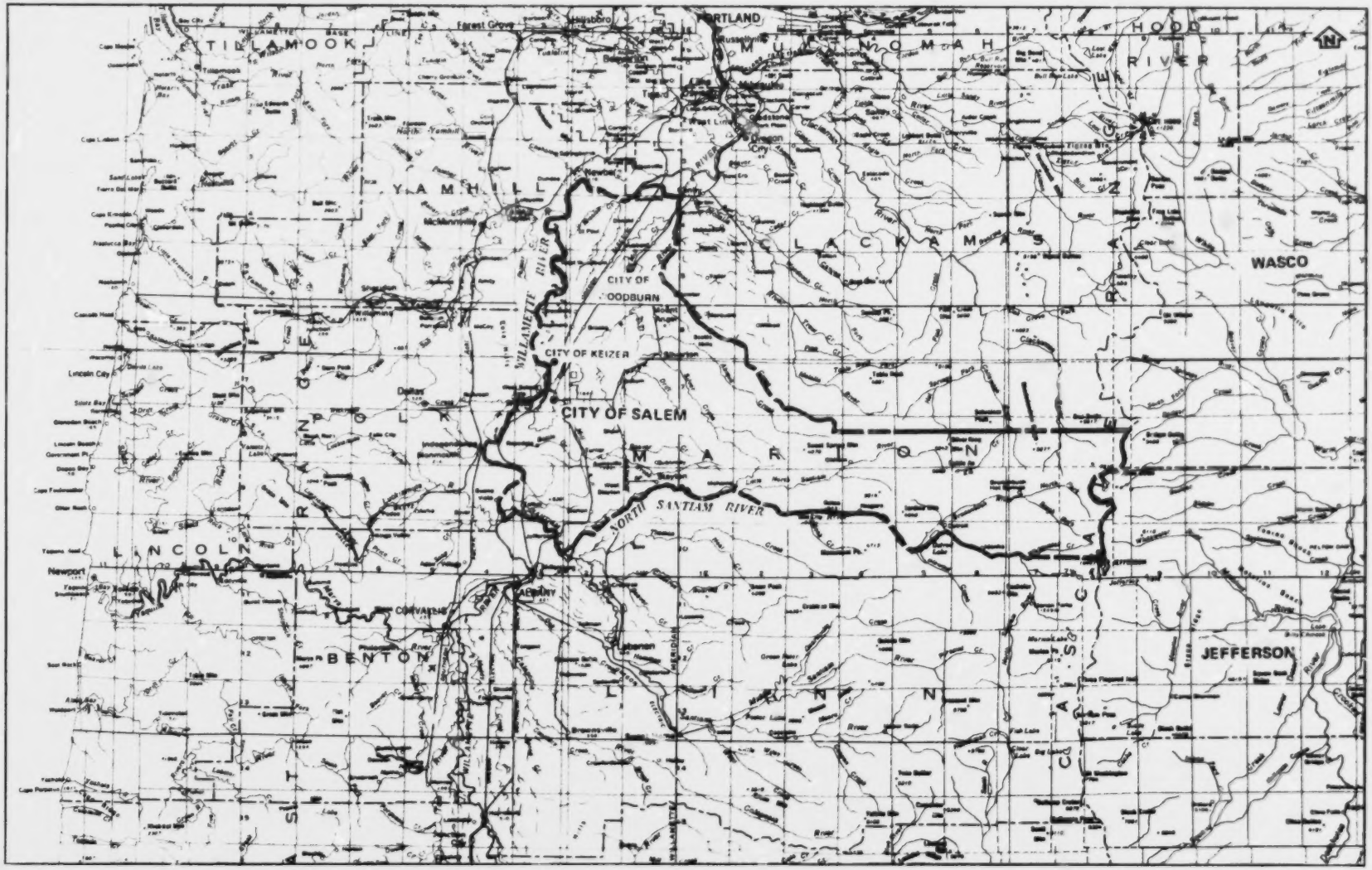

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48

VICINITY MAP

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Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Marion County.

Table 1 lists the name of each flooding source, the reaches studied, and the method of study. River mile stations used in the list are consistent with those listed in the River Mile Index, Willamette River (Reference 7) and shown on USGS quadrangle maps (References 8 and 9).

2.2 Community Description

Marion County, located in northwestern Oregon, has an area of 1,166 square miles. It is bounded on the north and west by the Willamette River; on the south by the Santiam and North Santiam Rivers; and on the east by the Pudding River, Butte Creek, and the crest of the Cascade Mountain Range. Salem, the state capital and the county seat, is located in the extreme western part of the county, adjacent to the Willamette River. Portland, Oregon, is 47 miles north of Salem.

Marion County has had a steady increase in population at a rate usually greater than the average for the State of Oregon. From 1970 to 1975, the population in the incorporated areas rose from 86,904 to 106,220, a 22 percent increase. During the same period, the population in the unincorporated areas decreased from 64,405 to 60,680, a change of 5.8 percent (Reference 10). Annexation and incorporation are the major reasons for the growth of population in the incorporated areas and the loss of population in the unincorporated areas. The population of unincorporated areas of Marion County in 1980 was 56,464, and the total population of Marion County was 204,692 (Reference 11).

The economy of the county is based on agricultrue, forestry and light industry. Marion County is one of the leading counties in Oregon in terms of cash farm income.

Approximately 90 percent of the county's land use is agricultural or in forests (Reference 12). Most of the urban development in the county is located near the streams and rivers where historical needs for water supply and transportation could be met. Development in rural areas also tends to be near streams for agricultural reasons. In several areas of the county, residential and commercial developments have encroached onto the flood plains. Most of the flood plains in the county are devoted to agricultural uses.

Marion County is located in the center of the 11,200-square-mile Willamette River basin and is comprised of three geologic provinces. The western part of the county is in the Willamette Valley Trough province, which is characterized by very flat to gently rolling topography, ranging in elevation from approximately 60 to 500 feet.

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Table 1. Scope of Study

Flooding Source	Extent of Study (River Miles Above Mouth) From	To	Type of Study
Willamette River	41.3	73.9	Detailed
	73.9	76.9	Approximate
	76.9	89.4	Detailed
	89.4	109.0	Approximate
Santiam River	0.0	6.0	Approximate
	6.0	11.8	Detailed
North Santiam River	11.8	14.6	Detailed
	14.6	26.4	Approximate
	26.4	31.0	Detailed
	31.0	37.8	Approximate
	37.8	39.9	Detailed
	39.9	45.6	Approximate
	45.6	52.4	Detailed
	69.7	73.4	Detailed
Pudding River	4.8	6.7	Approximate
	6.7	11.5	Detailed
	11.5	60.8	Approximate
Mill Creek Near Woodburn	1.2	4.6	Approximate
	4.6	12.3	Detailed
Senecal Creek	0.0	2.0	Approximate
	7.7	8.9	Detailed
Butte Creek	0.0	12.1	Approximate
	12.1	13.5	Detailed
Little Bear Creek	0.0	0.8	Approximate

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Table 1. Scope of Study (Continued)

Flooding Source	Extent of Study (River Miles Above Mouth) From	To	Type of Study
Little Pudding River	0.0	8.9	Approximate
Lake Labish Ditch	0.0	6.8	Approximate
Tributary to Little Pudding River Near Hazel Green	0.0	3.1	Approximate
Howell Prairie Creek	0.0	3.0	Approximate
Abiqua Creek	0.0	8.1	Approximate
Davis Creek	0.0	1.3	Approximte
Silver Creek	0.0	1.2	Approxmate
	1.2	6.2	Detailed
	6.2	10.0	Approximate
Turner Bypass	0.0	0.3	Detailed
Drift Creek	0.0	6.5	Approximate
Mill Creek	3.5	4.1	Detailed
	6.0	21.7	Detailed
McKinney Creek	0.0	3.8	Approximate
Battle Creek	0.0	4.0	Approximate
	5.4	7.0	Detailed
Rodgers Creek	0.0	1.2	Approximate

Table 1. Scope of Study (Continued)

Flooding Source	Extent of Study (River Miles Above Mouth) From	To	Type of Study
Tributary of Mill Creek Near Turner	0.0	1.4	Approximate
Beaver Creek	0.0	3.6	Detailed
Claggett Creek	0.4	1.0	Detailed
	4.1	4.2	Detailed
	5.7	6.0	Detailed
East Fork Pringle Creek	3.3	3.5	Detailed
Middle Fork Pringle Creek	1.7	1.8	Detailed
Powell Creek	0.3	0.4	Detailed

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The generally flat terrain is interrupted by occasional groups of hills and buttes. The Western Cascade province is an older, broader portion of the Cascade Mountain Range and lies east of the Willamette Valley Trough. Elevations in this foothill province range from 300 to 5,000 feet.

The third province, the High Cascades, is located in extreme eastern Marion County. It is basically a high volcanic plateau ranging in elevation from 3,000 to 5,000 feet. The higher mountains and volcanic cones do reach above 10,000 feet, however.

The Willamette River dominates the stream system in Marion County. All rivers and streams in the county ultimately drain to the Willamette River. The headwaters of most rivers and streams are either in the Western Cascades or High Cascades provinces. Streams in these provinces are usually steep to very steep, with deeply incised channels. As the streams emerge into the Willamette Valley Trough province, they become flat, meandering waterways. The main channels of most streams in this portion of the county are deeply cut into the flat terrain, making well-defined channels with broad, flat flood plains.

Marion County has a temperate maritime climate dominated by airflow from the Pacific Ocean. Warm, dry summers and mild, wet winters are typical for most of the county. During the winter, occasional continental airflow from the east can bring cold, clear weather to the county. Approximately 60 percent of the annual precipitation occurs during the period from November through February. Summer dry spells can last from 60 to 90 days. Average annual precipitation ranges from 40 inches, in low western parts of the county, to between 100 and 130 inches, in the mountainous eastern part of the county. Most precipitation in the higher elevations falls as snow. Vegetation in Marion County is determined by elevation. It ranges from valley farmland, to principal forest, to upper slope elevations, and pasture, hay forage crops, hops, and grains are the predominant crops. Cottonwood trees, alder trees, and brush line most rivers and streams. Douglas fir, hemlock, red cedar, true fir, and some pines are common trees in the forested areas of the county.

Soils in the county have been classified into 89 individual soil types and 23 soil associations by the SCS. Alluvial soils along the rivers and streams are mostly sands and gravels in steep areas, and silty clays in flatter areas. Most of the Willamette Valley Trough is covered with Willamette silt, which is made up of silt, sandy silt, clayey silt, and silty clay. Soil type usually is unimportant when major rainfalls occur, because during major storms in winter, the soil is fully saturated.

Most of the material presented in this section was taken from the Comprehensive Plan for Marion County (Reference 12) and the Willamette Basin Comprehensive Study (Reference 13).

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2.3 Principal Flood Problems

The Willamette River and its tributaries have had a long history of flooding. Historical documents refer to major floods on the Willamette River in 1813, 1843, 1844, 1852, and 1861. The flood of 1861 is said to have been the largest flood in history to occur on the Willamette River at Salem, Oregon. Table 2 shows the 10 greatest known observed floods on the Willamette River at Salem (Reference 14). Variations in the relationship between the discharges and elevations is the result of changes in the channel which have taken place over the years.

The flood peaks listed for 1943 and 1964 were reduced from natural conditions by the construction of several upstream reservoirs. The computed natural peak discharges for the 1943 and 1964 floods are 301,000 and 472,000 cubic feet per second (cfs), respectively. The 1964 computed natural discharge is very close to the maximum flood of record, which occurred in December 1861.

With development increasing in flood plains, major amounts of damage can be expected as a result of major floods. During flooding at Keizer (downstream of Salem) during the December 1964 flood, more than 1,000 people were evacuated and numerous homes were damaged or destroyed by the floodwater of the Willamette River. The December 1964 flood at Salem was approximately a 100-year flood.

Flooding on the tributary streams of the Willamette River occurs as a result of the same area-wide storms from the Pacific Ocean. Warm, moist air from the Pacific Ocean brings heavy precipitation, which sometimes falls on snow-covered or frozen ground. Orographic effects of the Cascade Range cause higher precipitation amounts in the headwaters of the tributary streams. This, in combination with melting snowpack at the higher elevations, causes major flooding along the whole length of the tributaries.

Flood peaks on the tributaries usually lead the peaks on the Willamette River and are of shorter duration. Rivers and streams can stay out of their banks for 2 to 10 days. Storm intensity and path play a major role in the timing and magnitude of flood peaks on the Willamette River and its tributaries.

Because most of the tributary streams originate in forested areas, logs and other debris can be expected to obstruct bridge openings and reservoirs. Ice jams are not a problem in the county because of the warm winter temperatures. Individual bridges or buildings may impede floodflows in some areas, but, generally, the width of the flood plain and flat slopes of the rivers produce a natural aggregation of flood problems.

The data presented in this section were taken from Appendix E of a report by the Pacific Northwest River Basins Commission (Reference 13)

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Table 2. Magnitude of Known Floods,
Willamette River at Salem, Oregon

Date of Crest	Gage Height Stage (Feet)	Gage Height Elevation (Feet)	Peak Discharge (cfs)
December 4, 1861	47.0	153.1	500,000
February 5, 1890	45.1	151.2	448,000
January 16, 1881	44.3	150.4	428,000
January 8, 1923	38.3	144.4	348,000
January 15, 1901	39.5	145.6	329,000
February 6, 1907	39.3	145.4	325,000
November 25, 1909	38.5	144.6	315,000
December 23, 1964	37.78	143.9	308,000
January 2, 1943	38.6	144.7	291,000
January 27, 1903	36.6	142.7	283,000

and a report by the COE (Reference 14). Both reports contain extensive detail on flooding problems in Marion County.

Figures 2 through 21 show the level of the 100-year flood at various points throughout Marion County. These points correspond with areas where detailed study methods were used. Figures 22 through 27 show the December 1964 flood at various points throughout the county.

2.4 Flood Protection Measures

Flood protection along the major streams of Marion County is provided by a network of flood-control reservoirs in the upper reaches of the streams. The North Santiam River is protected below Detroit Dam, and the Santiam River has Detroit, Foster, and Green Peter Reservoirs located on its north and south forks. The Willamette River in Marion County is protected by the three reservoirs listed above, plus the Fern Ridge, Cottage Grove, Dorena, Lookout Point, Hills Creek, Cougar, Blue River, and Fall Creek Reservoirs. Only the Detroit Reservoir is located within Marion County.

Private and public agencies have built dikes and revetments for flood control and erosion protection along the Willamette, Santiam, and North Santiam Rivers. The SCS's Lake Labish drainage project provides protection from only a 25-year frequency flood. The only other flood-protection projects are in the Mill Creek (near Salem) drainage basin. Bypass channels have been constructed for Turner and Salem, and Beaver Creek has been channelized. The SCS has also proposed several flood storage reservoirs for this basin (Reference 15).

The National Weather Service in Portland, Oregon, is responsible for flood warning and river forecasting services in Marion County. Forecasts are available for the Willamette, Pudding, Santiam, and North Santiam Rivers during the flood season. River forecasts are issued daily for the Willamette River at Salem throughout the year. The National Weather Service station at Salem, Oregon, disseminates the river forecasts and general weather forecasts for Marion County.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence

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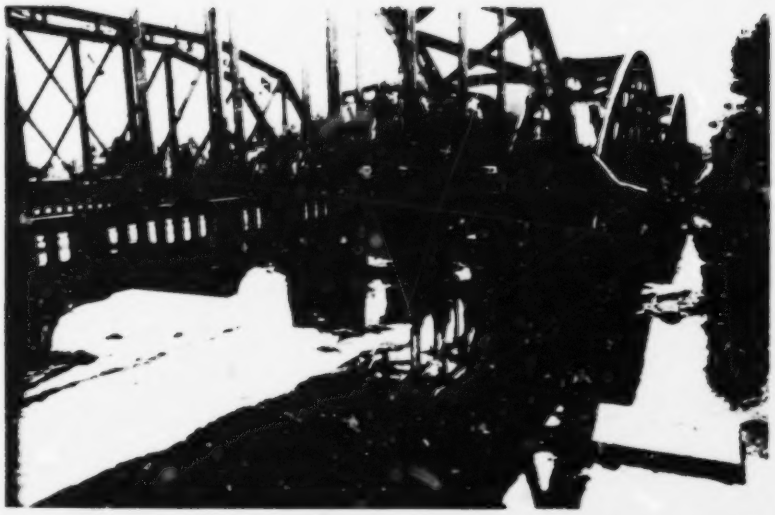

Figure 2. Looking Southwest at Jefferson Highway Bridge No. 164 and Southern Pacific Railroad Bridge Over the Santiam River, at Jefferson, September 1976 (The 100-Year Flood Will Be 9.5 Feet Beneath the Low Chord at the Center of the Bridge.)

Figure 3. Looking West Near Green's Bridge Over the North Santiam River, Near Jefferson, August 1976 (The 100-Year Flood Will Be 5.5 Feet Beneath the Low Chord at the Center of the Bridge.)

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Figure 4. Looking Northwest at Stayton-Scio Road Bridge Over North Santiam River, at Stayton, February 1977 (The 100-Year Flood will Be 5.5 Feet Beneath the Low Chord at the Center of the Bridge.)

Figure 5. Looking Southwest at First Avenue Bridge Over North Santiam River, at Mill City, February 1977 (The 100-Year Flood Will Be 18 Feet Below the Road at the Center of the Bridge.)

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Figure 6. Looking Southwest at Sorbin Avenue Bridge Over North Santiam River, at Gates, February 1977 (The 100-Year Flood Will Be 44 Feet Below Deck of Bridge.)

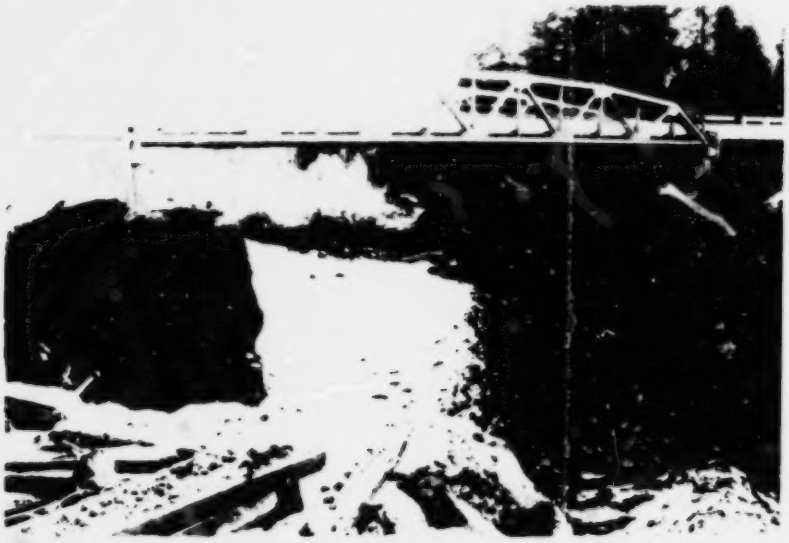

Figure 7. Looking East at New Church Street Bridge Over North Santiam River, at Idanha, February 1977 (The 100-Year Flood Will Be 11 Feet Below the Low Chord of the Bridge.)

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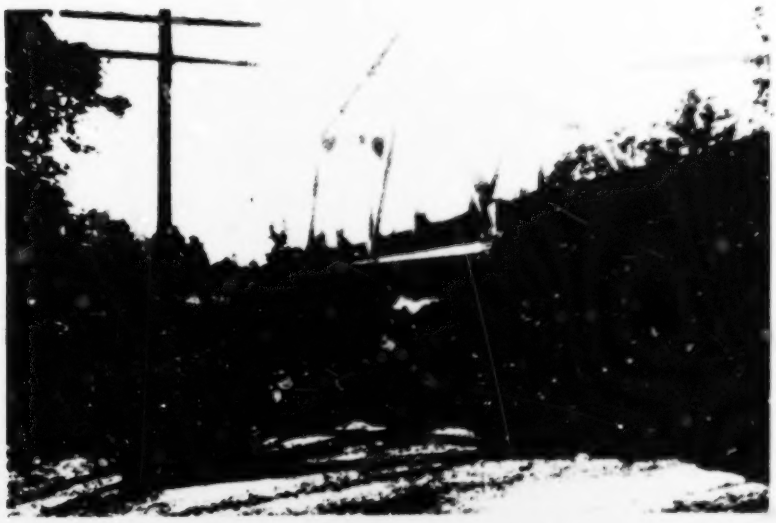

Figure 8. Looking West at the Southern Pacific Railroad Bridge Over the Pudding River, Near Aurora, August 1976 (The 100-Year Flood Will Be 12.5 Feet Below the Deck of the Bridge.)

Figure 9. Looking East Along Hubbard-Boones Ferry Road at Crossing Over Mill Creek, Near Hubbard, July 1976 (The 100-Year Flood Will Be 3 Feet Below the Road at the Culvert.)

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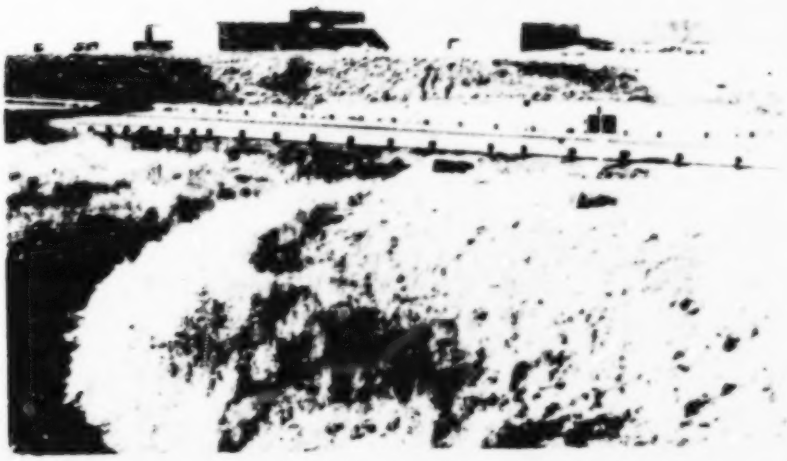

Figure 10. Looking North at Hillsboro-Silverton Highway 140 Box Culvert Over Mill Creek, at Woodburn, February 1977 (The 100-Year Flood Will Be 2 Feet Below the Highway at the Culvert.)

Figure 11. Looking West at Hillsboro-Silverton Highway 140 Bridge Over Senecal Creek, Near Woodburn, July 1976 (The 100-Year Flood Will Be 1.5 Feet Below the Road at the Center of the Bridge.)

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Figure 12. Looking Southeast Under 3rd Street Bridge Over Butte Creek, at Scotts Mills, February 1977 (The 100-Year Flood Will Be 17 Feet Beneath the Road at the Center of the Bridge.)

Figure 13. Looking North at Brush Creek Road Bridge Over Silver Creek, Near Woodburn, August 1976 (The 100-Year Flood Will Be 5.5 Feet Below the Road at the Center of the Bridge.)

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Figure 14. Looking South at Battle Creek Road Bridge Over Mill Creek, at Turner, March 1977 (The 100-Year Flood Will Be 1 Foot Below the Road at the Center of the Bridge.)

Figure 15. Looking Southwest at Mill Creek Road Bridge Over Mill Creek, Just Downstream From Confluence With Beaver Creek, March 1977 (The 100-Year Flood Will Be 1 Foot Over the Road at the Center of the Bridge.)

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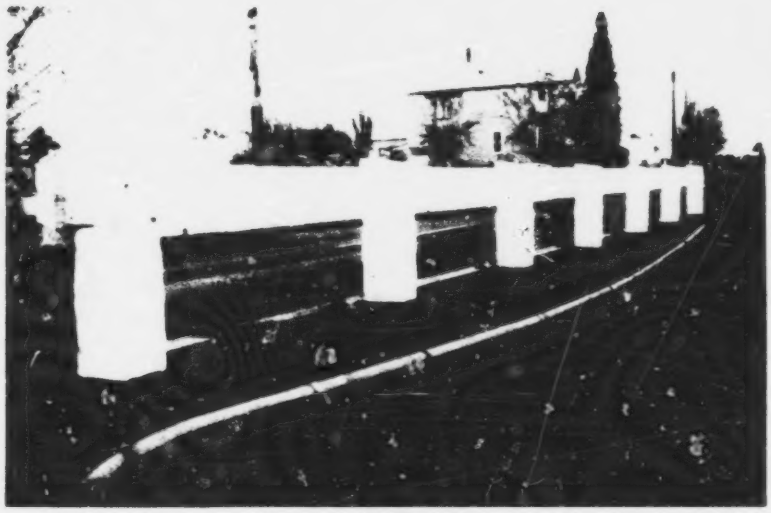

Figure 16. Looking North at the West Stayton-Aumsville Road Bridge Over Mill Creek, Near Aumsville, March 1977 (The 100-Year Flood Will Be 1 Foot Beneath the Road at the Center of the Bridge.)

Figure 17. Looking West at the Golf Club Road Bridge Over Mill Creek, Near Stayton, March 1977 (The 100-Year Flood Will be 2.5 Feet Beneath the Road at the Center of the Bridge.)

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Figure 18. Looking Northeast at Stayton-Sublimity Road Bridge Over Mill Creek, Near Stayton, March 1977 (The 100-Year Flood Will Be 1 Foot below the Road at the Center of the Bridge.)

Figure 19. Looking East at Southern Pacific Railroad Bridge Over the Turner Bypass, at Stayton, March 1977 (The 100-Year Flood Will Be 2.0 Feet Beneath the Top of the Railroad Trestle.)

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Figure 20. Looking East at 75th Place Southeast Bridge Over Beaver Creek, Near Aumsville, March 1977 (The 100-Year Flood Will Be 4.5 Feet Beneath the Road at the Center of the Bridge.)

Figure 21. Looking Northeast at the North Santiam Highway 22 Bridge Over Beaver Creek, Near Aumsville, March 1977 (The 100-Year Flood Will Be 3 Feet Beneath the Road at the Center of the Bridge.)

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Figure 22. Flooding From the Willamette River in Keizer, December 1964

Figure 23. Flooding From the Santiam River Near Jefferson, December 1964

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Figure 24. Flooding From the Pudding River Downstream of Confluence With Silver Creek, December 1964 (Bethany Road is Located Along Telephone Poles.)

Figure 25. Flooding From Abigua Creek at Silverton-Mt. Angel Road, December 1964

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Figure 26. Flooding From Mill Creek at the Turner Memorial Tabernacle, December 1964

Figure 27. Flooding From Mill Creek and Beaver Creek at Their Confluence, December 1964

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interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied by detailed methods affecting the community.

For the Willamette, Santiam, and North Santiam Rivers below Detroit Reservoir, flows were based on discharge-frequency curves developed by the COE. Floodflows on these rivers are regulated by the operation of storage reservoirs in the headwaters of the rivers, and peak flow reduction in these rivers has been determined by the COE.

For the Willamette River near Butteville, records for the Willamette River stream gage at Salem (USGS gage 14191000) were statistically analyzed utilizing the standard log-Pearson Type III distribution as outlined by the U.S. Water Resources Council (Reference 16). Natural discharge-frequency curves were developed for that gage using continuous records from 1893 through 1976 (Reference 17). A drainage area ratio was then applied to the Salem natural-frequency curves to determine discharges at other locations along the Willamette River. Regulated discharge-frequency curves were then prepared for each location using flood routing computations that took into account upstream storage projects.

The flows for the Willamette River near Salem were determined from the regulated discharge-frequency curve for the 1974 conditions on the Willamette River at Wilsonville (Reference 18). The flows were used directly because the change in drainage area is insignificant. This Wilsonville curve was in turn estimated from the discharge-frequency curve for the Willamette River at Salem as regulated by Fern Ridge, Cottage Grove, Dorena, Lookout Point, Hills Creek, Cougar, Detroit, Green Peter, Fall Creek, and Blue River Dams
(Reference 19).

The flows for the Santiam River at Jefferson come from the discharge-frequency curve for this location (Reference 20), as regulated by Detroit, Green Peter, and Foster Dams.

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The flows for the North Santiam River at Gates and Mill City are based on the regulated discharge-frequency curve for Detroit Dam (Reference 21).

These flows were adjusted for the change in flows between Detroit Dam and the study area based on a log-Pearson Type III frequency analysis of inflow per square mile. The flows at Stayton were determined from the regulated discharge-frequency curve for the North Santiam River at Mehama (Reference 22). The flows were used directly because the change in drainage area is insignificant between Mehama and Stayton, located just downstream. The flows for the North Santiam River at Greens Bridge (above the confluence with the Santiam River) are based on the regulated discharge-frequency curve for the North Santiam River at Mehama (Reference 22), and were adjusted by the drainage area factor 1.06, developed for the Greens Bridge location regulated discharge-frequency curve (Reference 23).

For the North Santiam River near Idanha, the annual peak flows for the USGS gage (No. 14-1780.00) were fit to the log-Pearson Type III distribution, and a weighted regional skew was applied. Forty-seven annual peaks recorded between 1928 and 1975 were used. This analysis was then in accordance with guidelines from the U.S. Water Resources Council (Reference 24).

Two hydrologic conditions were analyzed to determined the North Santiam River peakflows near Lyons. The first condition was used downstream of the confluence with the Little North Santiam River. For that condition, peak North Santiam River flows occur from Little North Santiam River peak discharges plus simultaneous contributions from Detroit project regulated discharges and local inflow between the dam and the study area. The second condition was used upstream of Little North Santiam River. North Santiam River discharges for that portion of the study reach would peak after the storm subsided. At that time, the Detroit project would increase outflow discharges to lower its reservoir.

Stream gage records for North Santiam and Little North Santiam Rivers have been statistically analyzed, utilizing the standard log-Pearson Type III distribution, as outlined by the U.S. Water Resources Council (Reference 24) to determine peak discharges near Lyons. The regulated discharge-frequency curves (References 25 and 26) for North Santiam River at Mehama, gage No. 141830, and Detroit project were used to determine discharges. The discharge-frequency curve for Little North Santiam River, gage No. 141825 (Reference 27), was also used to compute discharges considered in the hydrologic analyses.

For the Pudding River near Aurora, a log-Pearson Type III frequency analysis was performed, in accordance with the methods outlined by the U.S. Water Resources Council (Reference 24). USGS Pudding River stream gage (No. 14-2020.00) at Aurora has annual

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peak flows recorded between 1929 and 1964 (36 years). Ten more years of record were obtained by taking National Weather Service flood stage records at the same site for the period 1965 through 1975 and converting them to discharges by using the USGS 1964 rating table. Because of the length of record, a weighted regional skew was applied to the frequency analysis (Reference 24).

No stream gage records exist for Mill Creek and Senecal Creek, near Woodburn.

A detailed drainage study performed by Clark and Groff Engineers (Reference 28) lists flows that give flood elevations well in excess of local experience. Therefore, a regional methodology developed by the Oregon State Highway Division (Reference 29) was adopted. This method was selected because it shows the Willamette Valley floor as a separate region, and it is intended for small drainage areas (less than 50 square miles). The results were used directly for Senecal Creek, but were modified for Woodburn to include the effects of urbanization at Woodburn and the routing capacity of the stream channel through Woodburn. Design discharge charts, presented in the Oregon State Highway Division Hydraulics Manual, were also used for Battle Creek.

To modify the regional flows, unit hydrographs were prepared, combined, and routed through the combination of storage reservoirs provided by the road embankments. The same percentage of flow reduction for the 100-year flood was then applied to the flows for the 10-, 50-, and 500-year floods developed from the regional methodology.

For Butte Creek, the USGS gage at Monitor (No. 14-2015.00) has 22 years of recorded annual peak flow recorded during the periods of 1940-52 and 1966-76. By correlation with annual peak flows for the USGS gage on the Molalla River above Pine Creek near Wilhoit (No. 14-1985.00), 19 additional peak flows were generated, giving a total record of 41 years. These data were fit to the log-Pearson Type III distribution, and an adjusted regional skew was applied (Reference 24).

For Silver Creek at Silverton (USGS No. 2003), the same method of analysis was used as detailed above for Butte Creek. The correlation with the Molalla River gage (No. 14-1985.00) generated 30 additional annual peaks which were combined with 11 years of recorded peaks (1964-68, 1971-76) to give a total record of 41 annual peaks. These data were fit to the log-Pearson Type III distribution with an adjusted regional skew applied (Reference 24).

The analyses for Butte and Silver Creeks included correlations with the Molalla River, because the 11 years of record for Silver Creek included several very high flows.

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The log-Pearson Type III frequency analysis of these 11 years of record indicated that the record flood of December 1964 was a 10-year flood. Most other gages in the area indicated that the 1964 flood was approximately a 100-year flood. The additional peaks generated by the correlation analysis resulted in a lowering of the frequency curve, so that the 1964 flood became an 85-year event, which is more representative of local experience. Methods prescribed by the U.S. Water Resources Council (Reference 24) were used in the analyses for Silver and Butte Creeks.

The Turner Bypass diverts flows from Mill Creek around downtown Turner. Flows in the bypass were determined by the hydraulics of the control structure that lets water from Mill Creek into the bypass channel. The split in flows was determined by backwater calculations that balanced flows and headlosses for both branches.

Floodflow-frequency data for Mill Creek and Beaver Creek were based on the analysis of annual peak flows at Oregon Water Resources Department Mill Creek stream gage No. 14191500 at Penitentiary Annex. Twenty-nine annual peak flows, 19 from USGS records from 1938 to 1956 (References 30 and 31) and 10 from Oregon Water Resources Department records from 1968 to 1977 (Reference 32), were fit to the log-Pearson Type III distribution with a zero skew coefficient (Reference 16).

Flows at upstream points on Mill Creek were developed by drainage basin ration in accordance with the following formula:

$$\frac{Q_1}{Q_2} = \frac{A_1}{A_2}^{0.95}$$

where: Q_1 = Flow at gage
Q_2 = Flow at point
A_1 = Area at gage
A_2 = Area at point

This equation is consistent with one developed by the USGS for their regional flood frequency report (Reference 33).

For Claggett Creek, the 10-, 50-, and 100-year-flood peak discharges were developed by the Marion County Department of Public Works from unpublished discharge-frequency curves using a rainfall-runoff model developed and described by the USGS (Reference 34). The 500-year-flood peak discharge was developed by extending the discharge-frequency curves on log-log paper.

Peak flows on the Middle and East Forks Pringle Creek are controlled by the overflows from Mill Creek during the 50-, 100-, and 500-year events.

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Natural peak flows on Powell Creek were determined by the transfer of Battle Creek flows using the formula cited earlier. The peak 50-, 100-, and 500-year flows on Powell Creek were then increased to account for overflow from Battle Creek downstream of Sunnyside Road SE.

One overflow leaves Mill Creek upstream of Interstate Highway 5, and flows through the Interstate Highway 5/Turner Road SE underpass and the Interstate Highway 5/Southern Pacific Railroad underpass, and into the East and Middle Forks of Pringle Creek. The overflows along East and Middle Forks of Pringle Creek combine into Pringle Creek and eventually flow into Shelton Ditch. A 100-year flow of 1,630 cfs is diverted through this overflow.

Peak discharge-drainage area relationships for the streams studied by detailed methods are shown in Table 3.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

All water-surface elevations in Marion County were determined with the use of the COE HEC-2 step-backwater computer program (References 35, 36, and 37). This program uses the standard step-backwater method of balancing total energy in order to determine water-surface elevation. The program is designed especially for riverine studies and can correctly include special conditions, such as levees and bridges.

Cross sections along Willamette River used in the initial study, North Santiam River near Lyons, Pudding River, Mill Creek near Woodburn, Senecal Creek, Butte Creek, Silver Creek, Mill Creek north of Turner corporate limits, Claggett Creek, East Fork Pringle Creek, and Middle Fork Pringle Creek were compiled using field surveying methods. Cross sections on the portion of Willamette River studied for the FIS for Yamhill County were obtained from the COE (Reference 38).

The above-water cross sections for Silver Creek below the Silverton corporate limits, Mill Creek near Turner, Beaver Creek, Santiam River, and North Santiam River near Stayton were taken by digitizing ground elevations from aerial photographs. The above-water cross sections for the remainder of the North Santiam River were taken using field surveying methods. Cross sections on Battle Creek, between Sunnyside Road and Interstate Highway 5, and on Powell Creek were taken from topographic maps at a scale of 1:1,200, with a contour interval of 2 feet (Reference 39). Where underwater cross sections were not field surveyed, these portions were added using average depths from field observations and were checked by backwater analysis. All bridges, culverts, and dams were field surveyed to obtain elevation data and structural geometry.

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Table 3. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Willamette River					
At Butteville	8,380	182,000	260,000	302,000	445,000
At Center Street Bridge Near Salem	7,280	163,000	232,000	269,000	390,000
Santiam River					
At Jefferson	1,790	89,500	134,000	158,000	231,000
North Santiam River					
At Greens Bridge	736	32,900	56,200	66,800	112,000
At Stayton	695	31,000	53,000	63,000	106,000
At Mill City	524	13,200	18,900	24,700	44,300
At Gates	494	12,900	18,300	23,800	43,200
At Idanha	216	15,000	22,000	26,800	36,000
At Mehama	665	28,000	43,000	52,000	93,000
Upstream of Confluence With Little North Santiam River	553	15,500	24,800	32,250	58,200
Pudding River					
At Cross Section A	517	18,000	26,900	31,200	41,500
At Cross Section D	480	16,800	25,200	29,200	38,800
Mill Creek (Near Woodburn)					
At Cross Section A	11.8	700	1,020	1,170	1,510
At Cross Section D	10.8	640	940	1,080	1,400
At Cross Section J	9.2	550	810	920	1,200

Table 3. Summary of Discharges (Continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Mill Creek (Near Woodburn) (Cont'd)					
At Cross Section O	7.6	460	670	770	1,010
At Cross Section R	7.1	430	620	720	940
At Cross Section U	6.3	390	570	650	840
At Cross Section W	4.5	230	340	390	510
At Cross Section AA	1.9	125	180	210	270
At Cross Section AC	1.2	80	120	140	170
Senecal Creek					
At Woodburn	4.0	250	370	420	550
Sutte Creek					
At Scotts Mills	54	5,630	8,150	9,260	12,000
Silver Creek					
At Silverton	48	3,930	5,500	6,200	7,900
Turner Bypass					
At Turner	67.1	1,430	2,400	2,640	3,440
Beaver Creek					
At Cross Section A	33.2	1,810	2,620	2,940	3,810
At Cross Section F	29.1	1,600	2,310	2,600	3,360
Mill Creek					
Below Interstate Highway 5	104.4	6,190	7,850[1]	8,550[1]	10,000[1]

[1]Reduction in Discharge to Overflow Losses

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Table 3. Summary of Discharges (Continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
At Oregon Water Resources Department Gage No. 14191500					
At Penitentiary Annex	104	6,190	8,950[1]	10,200[1]	13,300[1]
At Cross Section Y	102	5,600	8,100	9,100	11,800
At Cross Section AG	67.1	3,530	5,110	5,740	7,440
At Cross Section AH	62.7	3,310	4,790	5,380	6,980
At Cross Section AQ	22.2	1,230	1,790	2,010	2,600
At Cross Section BL	17.5	985	1,420	1,600	2,080
At Cross Section CH	14.8	840	1,220	1,360	1,770
Battle Creek					
At Interstate Highway 5 (Southbound)	9.8	590	870	990	1,310
At Sunnyside Road SE	5.4	330	490	555	730
Claggett Creek					
At Burlington Northern Railroad	7.6	690	890	950	1,080
At Interstate Highway 5	4.4	590	740	800	900
At North River Road	10	910	1,200	1,280	1,400
East Fork Pringle Creek					
At Mouth	1.4	70[2]	630[3]	655[3]	2,120[3]
Middle Fork Pringle Creek					
At Mouth	2.4	140[2]	340[3]	510[3]	940[3]
Powell Creek					
At Mouth	0.7	46	78	113	148

[1]Reduction in Discharge Due to Overflow Losses [2]Urbanized Runoff From Pringle Creek Basin
[3]Overflow From Mill Creek

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness values (Manning's "n") for each computation were determined on the basis of field inspection, as was underwater channel geometry at each cross section location. The Manning's "n" values varied from 0.015 to 0.100 for the channels and from 0.030 to 0.200 for the overbanks.

The starting water-surface elevations for the Willamette River were determined by the slope-area method, with the estimated slope of the energy grade line taken from the Willamette River profile.

The starting water-surface elevations for the Santiam and North Santiam Rivers were determined from profiles shown in a Flood Plain Information report (Reference 14) and normal-depth analysis. The profiles match within 0.5 foot the stage-discharge curve (Reference 40) for the USGS gaging station at Jefferson. High-water marks and crest-stage data were available for this reach, but changed conditions, and difficulty in locating the measurements precisely, made matching within less than 1 foot impractical.

The starting water-surface elevations for the North Santiam River at Stayton were determined by normal-depth analysis. Several cross sections were included downstream of the start of the detailed study to allow any errors in the starting elevations to be dissipated. High-water marks for the North Santiam River floods of 1945 and 1964, available from the COE, Portland District, could be used for only approximately calibrating the profiles because of changed conditions.

The starting water-surface elevations for the North Santiam River at Mill City and Gates were determined by normal-depth analysis and coordinated with a Flood Plain Information report profile (Reference 14).

The starting water-surface elevation for the North Santiam River at Idanha was the maximum pool elevation for the reservoir behind Detroit Dam. The profiles match within 0.5 foot the stage-discharge curve for the USGS gaging station at Idanha (Reference 41).

The starting water-surface elevations for the Pudding River were determined from profiles shown in a Flood Plain Information report (Reference 42) and normal-depth analyses. The profiles match within 0.5 foot the stage-discharge curve for the discontinued USGS gaging station at Aurora (Reference 43).

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The starting water-surface elevations for Senecal Creek, Mill Creek at Woodburn, and Butte Creek were determined by normal-depth analysis.

The starting water-surface elevation for Silver Creek was determined by assuming approximate backwater levels from the Pudding River. Several cross sections were included downstream of the start of the detailed study to allow any errors in the starting elevation to be dissipated. The profiles match within 0.5 foot the stage-discharge curve for the USGS gaging station at Silverton (Reference 44).

Beaver Creek starting water-surface elevations were taken from the hydraulic analysis of Mill Creek at the confluence with Beaver Creek. A 100-year profile (Reference 14) and crest gage data provided only approximate calibration because of the less detailed nature of this previous work.

The starting water-surface elevations for Mill Creek were taken from the Willamette River profiles.

The starting water-surface elevations for Battle Creek were determined by an analysis of the flow restriction caused by the culverts under Interstate Highway 5. The COE HEC-1 computer program (Reference 45) was used to route the flood hydrograph through the culverts and determine the time variation in the ponded water-surface elevation upstream of the culverts. The starting water-surface elevations for Powell Creek were taken from the Battle Creek profiles.

The starting water-surface elevations for Claggett Creek were calculated using the normal-depth method.

For East and Middle Forks of Pringle Creek, the starting water-surface elevations were taken from the Pringle Creek profile in the Salem FIS (Reference 4).

Generally, the distances on the flood profiles correspond to distances measured along the centering of the designated watercourses. For Mill Creek Overflow and segments of Middle and East Forks Pringle Creeks, however, the lack of any low-flow watercourses necessitated the use of distances measured along the centerline of the 100-year flow paths. On the maps, these flow lines, used to establish the respective profile distances, are delineated and labeled as Profile Base Lines.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps and orthophotos at scales and contour intervals indicated in Table 4. (References 9, 39, 46, 47, 48, 49, 50, 51, 52, 53, 54 and 55).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Flood plain boundaries are indicated on the Flood Insurance Rate Map. On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, A1-A8, A10-A12, A22 and A0; and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards (Zone B). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

For the portions of the Willamette, Santiam, and North Santiam Rivers studied by approximate methods, the 100-year flood boundaries were taken from Flood Plain Information reports prepared by the COE (Reference 14, 42, and 56).

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Table 4. Mapping Used for Detailed Study Flood Boundary Delineation

Flooding Source	Topographic Mapping Contour Interval	Topographic Mapping Scale	Stereophotos Scale
Willamette River			
At Clackamas County boundary	10 feet	1:4,800	
Along Yamhill County boundary	5 feet	1:6,000	
Remainder	10 feet	1:24,000	1:12,000
Santiam River			
At Jefferson	2 feet	1:1,200	1:12,000
Remainder	5 feet and 10 feet	1:24,000	1:12,000
North Santiam River			
At Lyons	40 feet	1:62,500	1:48,000
Remainder	5 feet and 10 feet	1:24,000	1:12,000
Pudding River	10 feet	1:24,000	1:12,000
Mill Creek (near Woodburn)			
At Woodburn	2 feet	1:1,200	
Remainder	10 feet	1:24,000	1:12,000
Senecal Creek	2 feet	1:1,200	1:12,000
Butte Creek	10 feet	1:24,000	1:12,000
Silver Creek	10 feet	1:24,000	1:12,000
Turner Bypass	5 feet	1:4,800	
Beaver Creek	5 feet	1:4,800	

Table 4. Mapping Used for Detailed Study Flood Boundary Delineation (Cont'd)

Flooding Source	Topographic Mapping Contour Interval	Topographic Mapping Scale	Stereophotos Scale
Mill Creek			
Upstream from Turner	5 feet	1:4,800	1:12,000
Downstream from Turner	4 feet	1:6,000	1:12,000
Battle Creek	10 feet	1:24,000	1:4,800 and 1:12,000
Claggett Creek			
Above Interstate Highway 5	10 feet	1:24,000	1:12,000
Below Burlington Northern Railroad	5 feet	1:24,000	1:12,000
East Fork Pringle Creek	2 feet	1:2,400	1:12,000
Middle Fork Pringle Creek	2 feet	1:2,400	1:12,000
Powell Creek	2 feet	1:2,400	1:12,000

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For the Pudding River and its tributary streams studied by approximate methods, the boundary of the 100-year flood was taken from USGS Flood-Prone Area maps at a scale of 1:24,000, with contour intervals of 10 and 20 feet (Reference 57).

Extensions of approximate areas above the limits mapped by the USGS or in approximate study areas not previously studied, were made by applying regional stage-frequency methods and using the available USGS quadrangle maps (References 8 and 9). Limited field verification and some flood photographs were also used for approximate areas not previously studied.

Approximate flood boundaries in some portions of the study area were taken from the Federal Insurance Administration's Flood Hazard Boundary Maps (Reference 59 and 60). The study contractor has determined that some areas shown on the Flood Hazard Boundary Map are areas of minimal flooding; therefore, they were not delineated on the maps.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain with the following exceptions. For the North Santiam River near Stayton, no encroachments were allowed beyond major floodwater channels because of the potential for major channel shifts during flooding. Encroachment was allowed near the North Santiam Highway 22 bridge and the Stayton water treatment plant where the bridge embankment and a revetment protect against channel shifts. For the North Santiam River at Mill City and Gates, and most of Butte Creek and Silver Creek, flooding is confined to the channel and the floodway corresponds exactly to the 100-year flood plain to prevent encroachment into the main channel. No floodway on the

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East and Middle Forks of Pringle Creek or the North Santiam River at Lyons was determined. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 5).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

It should be noted that if a significant portion of the Mill Creek-Beaver Creek floodway fringe is obstructed from carrying floodwater, the resulting loss of overbank storage may significantly increase peak flows and flood elevations downstream.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 28.

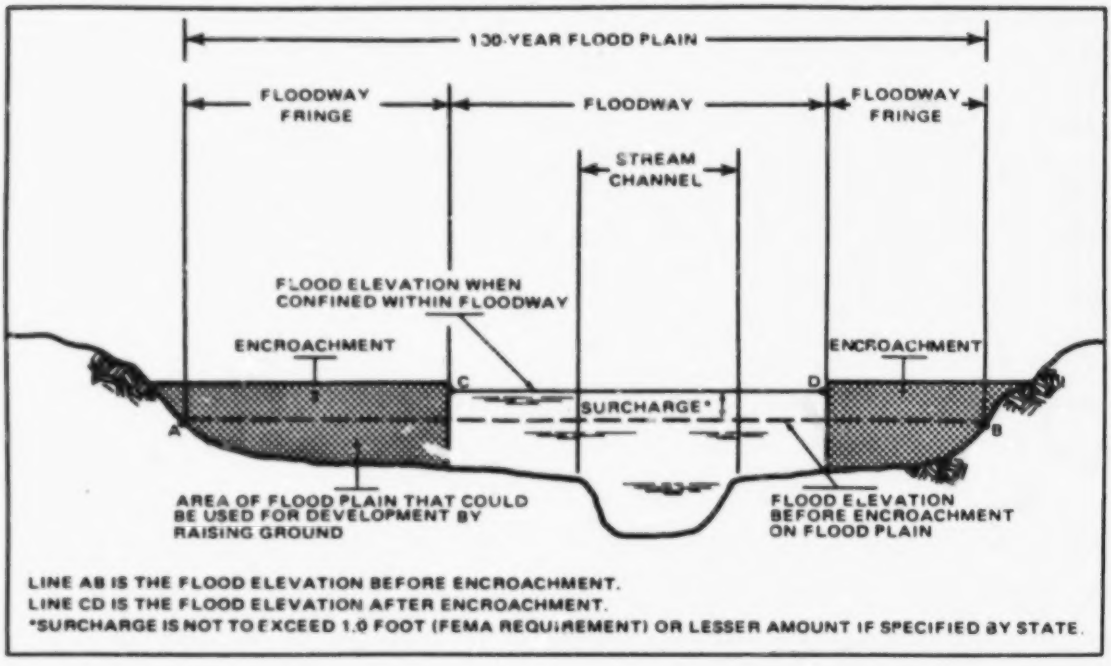
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 28. Floodway Schematic

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Willamette River								
A	42.03	710/370	43,332	6.6	93.7	93.7	94.6	0.9
B	42.35	730/440	43,718	6.6	93.9	93.9	94.8	0.9
C	42.66	700/385	43,336	6.6	94.1	94.1	94.9	0.8
D	42.99	709/374	43,605	6.6	94.3	94.3	95.1	0.8
E	43.30	680/381	39,287	7.4	94.4	94.4	95.2	0.8
F	43.76	680/370	39,838	7.2	94.7	94.7	95.6	0.9
G	44.15	700/415	40,368	7.1	95.0	95.0	95.9	0.9
H	44.46	750/430	41,438	6.9	95.3	95.3	96.0	0.7
I	46.44	2,100/ 1,690	47,272	6.1	96.2	96.2	97.0	0.8
J	47.64	3,000/ 2,525	56,285	5.1	97.5	97.5	98.1	0.6
K	48.41	3,000/ 2,540	46,825	6.1	97.5	97.5	98.2	0.7
L	48.46	3,000/ 2,550	47,512	6.0	97.5	97.5	98.4	0.9
M	49.07	4,400/ 4,070	77,593	3.7	98.5	98.5	99.3	0.8
N	50.65	8,000/ 7,380	139,912	2.1	99.3	99.3	100.1	0.8
O	51.59	8,000/ 6,050	129,683	2.2	99.5	99.5	100.4	0.9
P	52.48	7,700/ 7,375	82,487	3.5	99.5	99.5	100.4	0.9
Q	54.17	6,380/ 4,910	78,869	3.6	100.5	100.5	101.4	0.9

[1]Miles Above Mouth [2]Total Width/Width Within Unincorporated Marion County

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Willamette River (Cont'd)								
R	54.58	5,380/ 2,260	112,389	2.5	101.4	101.4	102.3	0.9
S	55.17	4,500/ 625	74,363	3.4	101.4	101.4	102.3	0.9
T	55.71	4,100/ 840	76,317	3.3	101.8	101.8	102.6	0.8
U	56.44	3,600/ 3,240	88,098	2.9	102.2	102.2	103.0	0.8
V	57.53	7,000/ 6,760	144,467	1.8	102.6	102.6	103.4	0.8
W	58.47	8,000/ 7,755	210,016	1.2	102.9	102.9	103.8	0.9
X	59.06	7,400/ 7,100	172,084	1.5	102.9	102.9	103.8	0.9
Y	59.42	7,800/ 7,260	199,965	1.3	103.3	103.3	104.1	0.8
Z	59.77	8,100/ 5,965	218,569	1.2	103.6	103.6	104.4	0.8
AA	60.38	7,800/ 3,310	203,415	1.3	103.8	103.8	104.7	0.9
AB	60.82	7,000/ 2,745	186,484	1.4	104.2	104.2	105.1	0.9
AC	61.81	6,400/ 335	134,860	1.9	104.6	104.6	105.6	1.0

[1]Miles Above Mouth [2]Total Width/Width Within Unincorporated Marion County

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Willamette River (Cont'd)								
AD	62.30	7,000/ 1,355	139,607	1.8	105.1	105.1	106.1	1.0
AE	63.23	8,500/ 215	166,468	1.5	105.5	105.5	106.4	0.9
AF	64.63	6,900/ 3,290	139,117	1.8	105.9	105.9	106.8	0.9
AG	65.58	8,400/ 3,575	141,703	1.8	106.4	106.4	107.3	0.9
AH	66.32	8,400/ 2,860	116,173	2.2	106.9	106.9	107.7	0.8
AI	67.45	10,400/ 370	122,794	2.1	107.6	107.6	108.3	0.7
AJ	68.12	12,300/ 875	121,997	2.1	107.9	107.9	108.6	0.7
AK	68.98	13,900/ 200	153,103	1.6	108.2	108.2	108.9	0.7
AL	69.55	13,600/ 1,270	164,805	1.5	108.4	108.4	109.2	0.8
AM	70.20	11,500/ 570	143,995	1.7	108.6	108.6	109.4	0.8
AN	71.23	10,400/ 5,435	109,917	2.3	109.3	109.3	110.2	0.9
AO	71.80	4,000/ 3,875	54,682	4.6	110.2	110.2	111.1	0.9

[1]Miles Above Mouth [2]Total Width/Width Within Unincorporated Marion County

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Willamette River (Cont'd)								
AP	72.35	2,300/1,300[2]	28,961	8.6	111.2	111.2	112.2	1.0
AQ	73.94	3,600/3,180[2]	50,844	4.9	116.1	116.1	117.0	0.9
AR	76.93	2,264[3]	31,491	8.54	123.2	123.2	123.8	0.6
AS	77.42	1,404[4]	28,563	9.42	124.7	124.7	125.4	0.7
AT	78.19	4,200[4]	56,126	4.79	127.9	127.9	128.6	0.7
AU	78.59	3,150[4]	41,191	6.53	129.0	129.0	129.6	0.6
AV	78.92	3,250[4]	47,502	5.66	130.4	130.4	130.8	0.4
AW	79.25	2,675[4]	36,281	7.41	131.2	131.2	131.7	0.5
AX	79.99	2,969[4]	56,800	4.74	134.1	134.1	134.5	0.4
AY	81.06	4,456[4]	62,794	4.28	135.6	135.6	136.3	0.7
AZ	82.16	3,613[4]	51,870	5.19	137.9	137.9	138.6	0.7
BA	83.08	2,570[4]	49,133	5.47	140.1	140.1	140.9	0.8
BB	83.65	1,540[4]	34,623	7.77	141.4	141.4	142.1	0.7
BC	83.88	1,290[4]	39,581	6.80	142.3	142.3	143.0	0.7
BD	84.22	2,485[4]	62,653	4.29	143.2	143.2	143.8	0.6
BE	84.98	4,405[4]	86,932	3.09	144.4	144.4	145.0	0.6
BF	85.35	4,950[4]	103,160	2.61	144.8	144.8	145.3	0.5
BG	85.72	5,130[4]	87,316	3.08	144.9	144.9	145.5	0.6
BH	86.13	1,800/3,000[5]	86,158	3.12	145.3	145.3	145.8	0.5

[1]Miles Above Mouth [2]Total Width/Width Within Unincorporated Marion County [3]Width Lies Entirely Outside County Limits
[4]Width Extends Beyond County Limits [5]Left Channel/Right Channel

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Willamette River (Cont'd)								
BI	86.36	1,650/3,000[2]	76,469	3.52	145.5	145.5	146.0	0.5
BJ	86.66	2,200/3,000[2]	81,487	3.30	145.8	145.8	146.3	0.5
BK	87.01	6,462[3]	87,854	3.06	146.1	146.1	146.8	0.7
BL	87.41	6,330[3]	74,102	3.36	146.5	146.5	147.2	0.7
BM	87.78	6,827[3]	89,237	3.01	146.9	146.9	147.8	0.9
BN	88.58	6,750[3]	101,527	2.65	148.0	148.0	148.7	0.7
BO	88.96	5,350[3]	82,965	3.24	148.3	148.3	149.0	0.7
BP	89.35	3,900[3]	80,271	3.35	148.6	148.6	149.5	0.9

[1]Miles Above Mouth [2]Left Channel/Right Channel [3]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

WILLAMETTE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Santiam River								
A	31,680	8,030	51,066	3.10	201.5	201.5	202.5	1.0
B	32,060	8,400	16,532	9.60	202.0	202.0	203.0	1.0
C	32,430	9,096	60,571	2.60	203.9	203.9	204.9	1.0
D	34,030	7,560	36,564	4.30	204.6	204.6	205.4	0.8
E	35,530	5,146	22,994	6.90	205.7	205.7	206.3	0.6
F	37,530	5,900	31,996	5.00	208.6	208.6	209.5	0.9
G	39,080	4,025	28,000	5.70	209.5	209.5	210.5	1.0
H	40,620	4,190	22,118	7.20	211.0	211.0	212.0	1.0
I	42,010	4,267	28,872	5.50	214.4	214.4	215.4	1.0
J	43,910	5,518	45,824	3.50	216.3	216.3	217.3	1.0
K	45,590	6,758	65,667	2.40	216.9	216.9	217.8	0.9
L	47,410	5,407	51,219	3.10	217.4	217.4	218.3	0.9
M	49,030	5,356	43,606	3.60	218.1	218.1	219.0	0.9
N	52,800	2,285	20,827	7.60	223.7	223.7	224.0	0.3
O	54,515	1,345	18,205	8.70	225.8	225.8	226.5	0.7
P	56,085	2,006	24,849	6.4	227.8	227.8	228.7	0.9
Q	58,005	2,511	33,936	4.7	229.1	229.1	230.0	0.9
R	59,555	2,919	32,164	4.9	229.6	229.6	230.5	0.9
S	61,080	3,096	32,819	4.8	230.4	230.4	231.3	0.9

[1]Feet Above Mouth

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

SANTIAM RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
North Santiam River								
A	62,680	3,840	35,962	1.9	231.4	231.4	232.3	0.9
B	64,030	2,655	28,819	2.3	231.8	231.8	232.7	0.9
C	66,280	2,649	23,434	2.8	232.9	232.9	233.8	0.9
D	67,780	3,076	19,824	3.4	234.0	234.0	234.9	0.9
E	69,360	2,266	14,095	4.7	236.6	236.6	237.4	0.8
F	70,940	1,736	7,378	9.1	242.1	242.1	242.5	0.4
G	72,470	2,550	12,106	5.5	246.8	246.8	247.7	0.9
H	73,900	1,643	9,114	7.3	249.2	249.2	249.9	0.7
I	75,600	615	5,975	11.2	252.4	252.4	253.2	0.8
J	76,825	588	5,912	9.7	255.6	255.6	256.4	0.8
K	77,075	462	6,035	11.1	255.7	255.7	256.6	0.9
L	77,335	405	4,826	13.8	255.7	255.7	256.6	0.9
BA	139,480	2,977	9,769	6.4	410.5	410.5	411.5	1.0
BB	142,090	3,752	18,217	3.5	419.1	419.1	419.1	0.0
BC	143,450	3,368	8,705	7.2	421.9	421.9	422.3	0.4
BD	145,110	3,358	14,364	4.4	429.4	429.4	430.0	0.6
BE	146,620	2,085	7,934	7.9	433.7	433.7	434.4	0.7
BF	147,830	1,638	9,557	6.6	438.1	438.1	438.7	0.6
BG	147,910	1,548	5,446	11.6	438.5	438.5	438.9	0.4
BH	147,990	1,547	9,590	6.6	439.9	439.9	440.5	0.6
BI	149,070	1,539	7,858	8.0	442.6	442.6	442.8	0.2
BJ	150,790	2,227	14,987	4.2	448.8	448.8	449.8	1.0
BK	152,580	2,950	12,247	5.1	454.1	454.1	454.1	0.0
BL	154,540	3,936	7,705	8.2	462.7	462.7	462.8	0.1

[1]Feet Above Mouth of Santiam River

[2]Width Extends Beyond County Limits

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

NORTH SANTIAM RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH [2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
North Santiam River (Cont'd)								
BM	155,630	3,589	12,385	5.1	468.7	468.7	469.0	0.3
BN	157,150	1,874	7,281	8.7	474.9	474.9	475.4	0.5
BO	158,490	2,603	12,508	5.0	480.1	480.1	480.1	0.0
BP	159,840	2,171	7,814	8.0	483.3	483.3	483.3	0.0
BQ	161,090	2,139	9,611	6.6	489.7	489.7	490.2	0.5
BR	162,540	2,793	15,866	4.0	495.1	495.1	495.2	0.1
BS	163,850	3,431	14,966	4.2	498.3	498.3	498.3	0.0
CA	241,000	389	1,938	12.7	767.0	767.0	767.0	0.0
CB	242,390	310	2,658	9.3	774.3	774.3	774.3	0.0
CC	244,970	273	2,369	10.4	781.9	781.9	781.9	0.0
CD	253,110	230	2,385	10.3	823.7	823.7	823.7	0.0
CE	254,930	248	2,530	9.8	829.9	829.9	829.9	0.0
CF	256,730	239	2,696	9.2	834.8	834.8	834.8	0.0
CG	258,230	191	1,665	14.8	838.9	838.9	838.9	0.0
CH	259,980	240	2,617	9.1	849.3	849.3	849.3	0.0
CI	262,220	210	1,539	15.4	857.2	857.2	857.2	0.0
CJ	263,960	200	2,367	10.0	869.1	869.1	869.1	0.0
CK	265,630	180	1,701	14.0	876.4	876.4	876.4	0.0
CL	267,630	291	2,743	8.7	887.0	887.0	887.0	0.0
CM	269,190	118	1,611	14.8	897.4	897.4	897.4	0.0
CN	272,940	224	1,867	12.7	913.1	913.1	913.1	0.0
CO	275,300	197	2,414	9.8	923.2	923.2	923.2	0.0
CP	276,630	237	1,620	14.7	929.6	929.6	929.6	0.0
DA	385,650	370	2,283	11.7	1,767.5	1,767.5	1,767.5	0.0
DB	387,740	197	1,740	15.4	1,791.6	1,791.6	1,791.6	0.0

[1] Feet Above Mouth of Santiam River

[2] Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

NORTH SANTIAM RIVER

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Pudding River								
A	35,376	4,106	17,209	1.8	95.9	95.9	96.9	1.0
B	37,076	3,109	15,386	2.0	96.6	96.6	97.6	1.0
C	39,006	2,063	13,511	2.3	97.5	97.5	98.5	1.0
D	40,846	950	6,542	4.5	99.3	99.3	100.1	0.8
E	40,910	893	15,666	1.9	100.1	100.1	101.1	1.0
F	40,971	881	9,594	3.0	100.1	100.1	101.1	1.0
G	43,741	670	8,122	3.6	102.2	102.2	103.2	1.0
H	43,811	556	6,882	4.2	102.2	102.2	103.2	1.0
I	43,881	674	8,286	3.5	102.3	102.3	103.3	1.0
J	46,181	1,811	21,912	1.3	103.1	103.1	104.1	1.0
K	49,431	2,510	29,989	1.0	103.5	103.5	104.5	1.0
L	51,731	1,658	17,849	1.6	103.8	103.8	104.8	1.0
M	52,941	684	8,134	3.6	104.2	104.2	105.1	0.9
N	54,391	2,050	21,313	1.4	105.2	105.2	106.2	1.0
O	55,811	1,502	17,463	1.7	105.5	105.5	106.5	1.0
P	57,111	2,067	24,461	1.2	105.8	105.8	106.8	1.0
Q	60,741	1,244	10,601	2.8	106.4	106.4	107.4	1.0

[1]Feet Above Mouth [2]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

PUDDING RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (Near Woodburn)								
A	24,024	217	693	1.7	120.2	120.2	121.2	1.0
B	26,024	87	386	3.0	123.0	123.0	124.0	1.0
C	27,474	193	617	1.9	125.6	125.6	126.5	0.9
D	29,794	25	199	5.4	129.5	129.5	130.4	0.9
E	31,154	142	515	2.1	132.0	132.0	133.0	1.0
F	32,364	77	341	3.2	134.0	134.0	134.8	0.8
G	33,864	77	420	2.6	136.1	136.1	137.0	0.9
H	33,974	13	126	8.6	138.1	138.1	138.8	0.7
I	34,024	178	1,033	1.0	138.1	138.1	138.8	0.7
J	36,144	84	404	2.3	138.7	138.7	139.5	0.8
K	36,282	10	108	8.5	138.7	138.7	139.5	0.8
L	36,332	142	832	1.1	140.7	140.7	141.3	0.6
M	38,192	58	337	2.7	141.3	141.3	142.0	0.7
N	40,122	106	458	2.0	143.1	143.1	144.1	1.0
O	41,707	46	271	2.8	144.5	144.5	145.5	1.0
P	43,332	65	347	2.2	145.8	145.8	146.7	0.9
Q	44,957	94	427	1.8	146.8	146.8	147.7	0.9
R	45,777	91	370	1.9	147.4	147.4	148.3	0.9
S	45,858	11	97	7.4	148.9	148.9	149.9	1.0
T	45,939	100	672	1.1	150.4	150.4	151.2	0.8
U	47,029	89	525	1.2	150.4	150.4	151.4	1.0
V	48,709	86	364	1.8	151.5	151.5	152.5	1.0
W	51,332	20	150	3.7	154.2	154.2	154.9	0.7
X	51,477	14	113	3.5	154.4	154.4	155.2	0.8
Y	51,759	42	225	1.8	154.7	154.7	155.6	0.9
Z	52,609	100	354	1.1	155.3	155.3	156.0	0.7

[1] Feet Above Mouth

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK (NEAR WOODBURN)

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (Near Woodburn) (Cont'd)								
AA	59,464	100	403	0.5	170.8	170.8	171.0	0.2
AB	61,214	64	223	0.9	170.9	170.9	171.2	0.3
AC	63,284	14	20	6.9	171.6	171.6	172.1	0.5
AD	63,350	14	53	2.6	173.0	173.0	174.0	1.0
AE	63,415	86	271	0.5	173.3	173.3	174.3	1.0
AF	64,995	94	93	1.5	173.9	173.9	174.5	0.6
Senecal Creek								
A	40,392	113[2]	337	1.1	159.1	159.1	160.1	1.0
B	42,042	122[2]	410	1.0	160.6	160.6	161.6	1.0
C	46,869	25	120	3.5	167.0	167.0	167.9	0.9
D	46,932	46	254	1.7	167.2	167.2	168.2	1.0
E	46,995	25	127	3.3	167.2	167.2	168.2	1.0
Butte Creek								
A	63,730	87[3]	678	13.7	369.3	369.3	369.3	0.0
B	71,126	71[3]	610	15.2	462.8	462.8	462.8	0.0

[1]Feet Above Mouth [2]Width Lies Entirely Outside County Limits
[3]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK (NEAR WOODBURN)-SENECAL CREEK-BUTTE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Silver Creek								
A	6,340	970	918	6.8	167.2	167.2	168.0	0.8
B	6,405	1,040	563	11.0	168.1	168.1	168.2	0.1
C	6,470	1,330	3,220	1.9	170.6	170.6	170.7	0.1
D	8,590	154	564	11.0	174.9	174.9	174.9	0.0
E	10,520	275	1,535	4.0	188.0	188.0	188.0	0.0
F	12,190	125	616	10.1	196.9	196.9	196.9	0.0
G	13,910	132	920	6.7	208.8	208.8	209.0	0.2
H	16,150	258[2]	1,641	3.8	219.0	219.0	219.9	0.9
I	23,325	67[2]	433	14.3	263.4	263.4	263.4	0.0
J	23,365	60[2]	606	10.2	266.0	266.0	266.0	0.0
K	23,400	78[2]	691	9.0	267.0	267.0	267.0	0.0
L	25,000	80[2]	385	16.1	276.0	276.0	276.0	0.0
M	25,040	51[2]	592	10.5	279.6	279.6	279.6	0.0
N	25,075	61[2]	594	10.4	279.6	279.6	279.6	0.0
O	27,375	93[2]	499	12.4	299.3	299.3	299.4	0.1
P	27,415	79[2]	656	9.5	301.5	301.5	301.5	0.0
Q	27,450	105[2]	746	8.3	301.9	301.9	301.9	0.0
R	29,340	78	493	12.6	315.0	315.0	315.0	0.0
S	29,375	67	518	12.0	316.0	316.0	316.0	0.0
T	29,410	83	650	9.5	317.0	317.0	317.0	0.0
U	31,460	129	559	11.1	338.5	338.5	338.5	0.0
V	32,950	92	640	9.7	354.8	354.8	354.8	0.0
Turner Bypass								
A	400	140	512	5.2	279.4	279.4	280.2	0.8
B	1,077	46	350	7.6	281.0	281.0	281.9	0.9
C	1,140	46	356	7.4	282.2	282.2	282.2	0.0

[1]Feet Above Mouth [2]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

SILVER CREEK-TURNER BYPASS

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Beaver Creek								
A	430	202	425	6.9	304.9	304.9	305.1	0.2
B	1,140	274	628	4.7	307.0	307.0	307.9	0.9
C	1,940	382	728	4.0	309.1	309.1	309.9	0.8
D	3,230	207	595	4.9	312.7	312.7	313.4	0.7
E	5,070	296	605	4.9	318.6	318.6	319.4	0.8
F	6,350	300	761	3.4	323.1	323.1	324.1	1.0
G	6,510	40	297	8.8	323.5	323.5	324.3	0.8
H	6,610	182	619	4.2	325.1	325.1	325.7	0.6
I	8,680	137	486	5.4	330.5	330.5	331.5	1.0
J	10,380	78	493	5.3	333.9	333.9	334.8	0.9
K	10,490	105	492	5.3	334.0	334.0	335.0	1.0
L	10,600	172	1,105	2.4	334.5	334.5	335.5	1.0
M	11,970	61	258	10.1	335.9	335.9	335.9	0.0
N	14,200	111	657	4.0	340.7	340.7	341.5	0.8
O	14,310	92[2]	551	4.7	340.8	340.8	341.7	0.9
P	14,430	186[2]	938	2.8	341.3	341.3	341.9	0.6
Q	15,560	224[2]	777	3.3	342.0	342.0	342.8	0.8
R	16,860	185[2]	388	6.7	346.2	346.2	346.6	0.4
S	18,170	184[2]	792	3.3	350.3	350.3	351.3	1.0
T	18,260	73	621	4.2	350.4	350.4	351.4	1.0
U	18,370	80	270	9.6	350.9	350.9	351.4	0.5
V	18,590	125	898	2.9	353.2	353.2	353.2	0.0
W	18,750	79	449	5.8	353.2	353.2	353.2	0.0
X	18,850	57	428	6.1	353.4	353.4	353.5	0.1
Y	19,000	113	552	4.7	354.1	354.1	354.1	0.0

[1]Feet Above Mouth [2]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

BEAVER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek								
A	19,678	250[2]	1,379	5.2	190.2	190.2	191.2	1.0
B	19,968	421[2]	1,979	3.6	191.0	191.0	192.0	1.0
C	21,668	232[2]	1,753	4.1	193.6	193.6	194.4	0.8
D	31,781	91[3]	866	9.9	222.3	222.3	222.5	0.2
E	31,971	91[2]	1,044	8.2	224.3	224.3	224.5	0.2
F	32,171	191[2]	1,634	5.2	225.9	225.9	225.9	0.0
G	32,946	1,532[2]	7,092	1.4	226.3	226.3	226.9	0.6
H	33,746	1,410[2]	4,619	2.2	226.6	226.6	227.3	0.7
I	34,021	1,494[2]	4,441	2.3	227.0	227.0	227.8	0.8
J	35,746	1,327[2]	3,048	3.3	231.1	231.1	231.7	0.6
K	36,796	1,350[2]	4,596	2.2	233.2	233.2	234.2	1.0
L	37,961	1,053[2]	1,854	5.5	236.5	236.5	237.0	0.5
M	38,536	983[3]	2,182	4.7	239.7	239.7	240.3	0.6
N	38,567	983[3]	2,485	4.1	240.6	240.6	240.6	0.0
O	39,082	640[3]	3,111	3.3	241.7	241.7	242.0	0.3
P	39,932	401[3]	2,303	4.4	242.6	242.6	243.1	0.5
Q	40,642	432[3]	2,218	4.6	244.1	244.1	244.9	0.8
R	41,767	462[3]	2,636	3.9	246.6	246.6	247.5	0.9
S	41,956	628[3]	3,127	3.3	247.1	247.1	248.0	0.9
T	43,606	489[3]	1,715	5.9	249.4	249.4	250.0	0.6
U	45,886	1,334[2]	3,658	2.8	256.6	256.6	257.6	1.0
V	48,061	1,033	2,659	3.8	262.3	262.3	263.2	0.9
W	48,711	844	2,989	3.4	264.3	264.3	265.1	0.8
X	49,586	490[2]	2,252	4.5	266.1	266.1	266.8	0.7
Y	49,978	489[2]	3,278	2.8	268.1	268.1	268.9	0.8
Z	50,320	198[2]	1,853	4.9	268.4	268.4	269.0	0.6

[1]Feet Above Mouth [2]Width Extends Beyond County Limits [3]Width Lies Entirely Outside County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (Cont'd)								
AA	51,335	179[2]	1,484	6.1	270.5	270.5	271.2	0.7
AB	52,935	153[2]	1,493	6.1	273.8	273.8	274.6	0.8
AC	54,185	490[2]	2,300	4.0	276.0	276.0	276.6	0.6
AD	54,388	530[2]	1,724	5.3	277.0	277.0	277.6	0.6
AE	54,438	589	5,208	1.7	277.5	277.5	278.0	0.5
AF	55,395	165[2]	941	6.1	277.7	277.7	278.1	0.4
AG	62,620	136[2]	584	9.2	289.4	289.4	289.7	0.3
AH	63,470	742	2,711	2.0	292.1	292.1	293.0	0.9
AI	64,800	236	655	8.2	294.3	294.3	294.4	0.1
AJ	64,950	93	755	7.1	295.1	295.1	296.1	1.0
AK	65,080	514	1,880	2.9	296.0	296.0	296.9	0.9
AL	67,080	252	891	6.0	299.4	299.4	300.0	0.6
AM	67,201	534	1,086	5.0	301.3	301.3	301.4	0.1
AN	67,280	534	1,814	3.0	301.7	301.7	302.4	0.7
AO	67,770	1,130	2,134	2.5	302.3	302.3	303.0	0.7
AP	68,520	704	1,372	1.5	303.1	303.1	303.8	0.7
AQ	68,730	505	952	2.1	303.2	303.2	304.0	0.8
AR	68,870	505	952	2.1	303.3	303.3	304.1	0.8
AS	69,870	402	650	3.1	305.0	305.0	306.0	1.0
AT	70,800	527	1,090	1.3	307.0	307.0	307.8	0.8
AU	70,880	527	1,090	1.8	307.5	307.5	308.1	0.6
AV	70,970	527	1,090	1.8	307.8	307.8	308.8	1.0
AW	71,610	565	817	2.5	308.7	308.7	309.2	0.5
AX	72,400	584	666	3.0	310.5	310.5	311.4	0.9
AY	72,500	675	1,040	1.9	311.2	311.2	312.1	0.9
AZ	72,565	608	1,190	1.7	311.3	311.3	312.3	1.0

[1]Feet Above Mouth [2]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Mill Creek (Cont'd)								
BA	74,465	94	484	4.2	315.4	315.4	316.1	0.7
BB	75,665	100	458	4.4	318.0	318.0	318.7	0.7
BC	75,785	59	331	6.1	318.2	318.2	319.0	0.8
BD	75,995	183	828	2.4	319.2	319.2	319.7	0.5
BE	76,835	71	308	6.5	320.0	320.0	320.6	0.6
BF	77,560	86	384	5.2	323.3	323.3	323.5	0.2
BG	77,708	72	278	7.2	324.0	324.0	324.2	0.2
BH	77,840	100	556	3.6	325.0	325.0	325.1	0.1
BI	80,310	92	385	5.2	328.6	328.6	329.0	0.4
BJ	82,220	350	931	2.2	332.5	332.5	333.3	0.8
BK	83,700	54[2]	161	9.9	340.5	340.5	340.7	0.2
BL	85,525	183[2]	650	2.5	347.0	347.0	348.0	1.0
BM	85,715	74[2]	312	5.1	347.5	347.5	348.4	0.9
BN	85,965	95[2]	382	4.2	348.2	348.2	349.1	0.9
BO	87,305	54[2]	188	8.5	353.7	353.7	354.1	0.4
BP	87,430	38[2]	179	9.0	355.5	355.5	355.5	0.0
BQ	87,505	169[2]	515	3.1	356.0	356.0	356.5	0.5
BR	89,405	232[2]	369	4.3	361.3	361.3	362.2	0.9
BS	89,535	365[2]	997	1.6	362.2	362.2	363.2	1.0
BT	89,725	299[2]	606	2.6	362.5	362.5	363.3	0.8
BU	91,075	246	303	5.3	367.0	367.0	367.0	0.0
BV	92,355	51	242	6.6	372.2	372.2	373.2	1.0
BW	92,530	60	278	5.8	373.2	373.2	374.0	0.8
BX	92,675	84	338	4.7	373.6	373.6	374.3	0.7
BY	93,650	83	280	5.7	376.6	376.6	377.1	0.5
BZ	95,450	98	372	4.3	381.9	381.9	382.1	0.2

[1]Feet Above Mouth [2]Width Extends Beyond County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

BEST COPY AVAILABLE

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek (Cont'd)								
CA	95,508	40	217	7.4	382.0	382.0	382.3	0.3
CB	95,575	173	693	2.3	383.2	383.2	383.4	0.2
CC	97,250	117	271	5.9	384.7	384.7	385.2	0.5
CD	98,860	138	404	4.0	392.4	392.4	392.4	0.0
CE	100,460	200	278	5.8	398.6	398.6	399.0	0.4
CF	102,180	100	358	4.5	406.4	406.4	407.4	1.0
CG	102,950	98	342	4.0	408.9	408.9	409.5	0.6
CH	103,190	50	355	3.8	409.1	409.1	410.1	1.0
CI	103,340	128	349	3.9	409.7	409.7	410.4	0.7
CJ	105,420	64	217	6.3	418.5	418.5	419.2	0.7
CK	107,360	108	320	4.2	427.2	427.2	428.2	1.0
CL	109,320	99	287	4.7	434.9	434.9	435.5	0.6
CM	110,950	64	275	4.9	440.6	440.6	441.5	0.9
CN	111,100	24	217	6.3	441.3	441.3	442.3	1.0
CO	111,220	74	361	3.8	442.3	442.3	442.9	0.6
CP	112,720	216	559	2.4	444.2	444.2	445.0	0.8
CQ	112,820	30	188	7.2	444.2	444.2	445.0	0.8
CR	112,940	135	468	2.9	445.7	445.7	446.2	0.5
CS	113,790	128	432	3.2	446.5	446.5	447.2	0.7
CT	114,330	60	313	4.3	447.4	447.4	448.1	0.7
CU	114,483	70	271	5.0	448.2	448.2	448.4	0.2
CV	114,680	42	201	6.8	448.2	448.2	449.2	1.0

[1]Feet Above Mouth

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Battle Creek								
A	28,410	440	1,258	0.5	402.0	402.0	402.1	0.1
B	29,535	55	146	3.8	404.7	404.7	405.7	1.0
C	30,940	16	53	8.7	420.7	420.7	421.7	1.0
D	32,445	20	78	5.9	443.7	443.7	444.6	0.9
E	32,780	13	57	8.1	447.0	447.0	447.7	0.7
F	33,730	14	60	7.7	475.0	475.0	475.6	0.6
Claggett Creek								
A	30,351	187	1,819	0.4	167.1	167.1	167.1	0.0
B	31,171	215	1,598	0.4	167.1	167.1	167.1	0.0
C	31,313	202	1,415	0.4	167.2	167.2	167.2	0.0
D	31,913	59	293	2.1	167.2	167.2	167.2	0.0
Powell Creek								
A	1,871	13[2]	13	5.8	393.3	393.3	393.3	0.0
B	2,203	20	42	1.9	397.1	397.1	397.7	0.6
C	2,258	12	26	2.9	398.3	398.3	398.3	0.0

[1]Feet Above Mouth

[2]Width Lies Entirely Outside County Limits

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOODWAY DATA

BATTLE CREEK-CLAGGETT CREEK-POWELL CREEK

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5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied by detailed methods affecting the unincorporated areas of Marion County.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard. In riverine areas, reaches are based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of the unincorporated areas of Marion County are shown on the Flood Profiles (Exhibit 1), and the reaches are summarized in Table 6.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone

BEST COPY AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Willamette River							
Reach 1	0025,0050 0075	-10.5	-3.2	10.5	110	A21	Varies - See Map
Reach 2	0075,0125	-6.5	-1.9	7.4	065	A13	Varies - See Map
Reach 3	0125,0175	-5.6	-1.3	3.2	055	A11	Varies - See Map
Reach 4	0175,0250 0275	-6.2	-1.9	4.7	060	A12	Varies - See Map
Pudding River							
Reach 1	0050,0100	-3.4	-1.0	+2.1	035	A7	Varies - See Map
Mill Creek (Near Woodburn)							
Reach 1	0100	-0.9	-0.3	+0.5	010	A2	Varies - See Map
Reach 2	0100	-1.8	-0.6	+1.6	020	A4	Varies - See Map
Reach 3	0100	-1.4	-0.5	+1.2	015	A3	Varies - See Map
Reach 4	0100	-1.9	-0.6	+2.2	020	A4	Varies - See Map
Reach 5	0075,0100 0125	-0.6	-0.2	+0.7	005	A1	Varies - See Map
North Santiam River							
Reach 1	0475	-3.1	-0.9	+2.5	030	A6	Varies - See Map
Reach 2	0500	-2.5	-0.6	+2.0	025	A5	Varies - See Map
Reach 3	0525	-4.1	-1.6	+5.1	040	A8	Varies - See Map
Reach 4	0525,0550	-3.6	-1.7	+4.9	035	A7	Varies - See Map
Reach 5	0650	-3.7	-1.5	+2.3	035	A7	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

WILLAMETTE RIVER-PUDDING RIVER-MILL CREEK-NORTH SANTIAM RIVER

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Senecal Creek							
Reach 1	0075	-0.5	-0.1	+0.3	005	A1	Varies - See Map
Reach 2	0075	-1.7	-0.5	+0.9	015	A3	Varies - See Map
Reach 3	0075	-0.8	-0.4	+0.9	010	A2	Varies - See Map
Butte Creek							
Reach 1	0150	-2.4	-0.7	+1.5	025	A5	Varies - See Map
Silver Creek							
Reach 1	0200	-1.7	-0.4	+1.1	015	A3	Varies - See Map
Reach 2	0200	-2.1	-0.6	+1.4	020	A4	Varies - See Map
Reach 3	0200	-1.5	-0.4	+0.9	015	A3	Varies - See Map
Turner Bypass							
Reach 1	0275	-1.7	-0.3	+0.6	020	A4	Varies - See Map
Beaver Creek							
Reach 1	0275	-0.5	-0.1	+0.3	005	A1	Varies - See Map
Reach 2	0275	-1.1	-0.3	+0.6	010	A2	Varies - See Map
Mill Creek							
Reach 1	0175	-0.5	-0.1	+0.2	005	A1	Varies - See Map
Reach 2	0275	-1.1	-0.3	+0.6	010	A2	Varies - See Map
Reach 3	0275	-1.8	-0.5	+0.9	020	A4	Varies - See Map
Reach 4	0275	-0.8	-0.2	+0.4	010	A2	Varies - See Map
Reach 5	0275,0300	-0.6	-0.1	+0.4	005	A1	Varies - See Map
Shallow Flooding	0275	N/A	N/A	N/A	N/A	A0	Depth 1

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SENECAL CREEK-BUTTE CREEK-SILVER CREEK-TURNER BYPASS-BEAVER CREEK-MILL CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Battle Creek							
Reach 1	0275	-0.6	-0.2	+0.4	005	A1	Varies - See Map
Claggett Creek							
Reach 1	0175	-0.9	-0.01	+0.3	010	A2	Varies - See Map
Reach 2	0175	-3.4	-1.1	+0.3	035	A7	167
East Fork Pringle Creek							
Reach 1	0275	-4.9	-0.4	+0.8	050	A10	Varies - See Map
Middle Fork Pringle Creek							
Reach 1	0275	-3.3	-0.7	+0.8	035	A7	Varies - See Map
Powell Creek							
Reach 1	0275	-0.5	-0.1	0.3	005	A1	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, OR
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

BATTLE CREEK-CLAGGETT CREEK-EAST FORK PRINGLE CREEK-MIDDLE FORK PRINGLE CREEK-POWELL CREEK

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number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zones A1-A8, A10-A12, and A22:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied by detailed methods affecting the community are summarized in Table 6.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the unincorporated areas of Marion County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance

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agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

Flood Insurance Studies for the incorporated cities of Aumsville, Gates, Idanha, Jefferson, Mill City, Scotts Mills, Silverton, Stayton, Turner, and Woodburn were prepared concurrently with the initial study. At contiguous points, the studies agree exactly.

A Flood Plain Information report (Reference 43) contains flood boundary maps and profiles for the Willamette and Pudding River reaches included in this study. Another Flood Plain Information report (Reference 14) contains profiles and flood boundary maps for the Santiam and North Santiam Rivers, and Mill Creek near Salem. The differences between the two Flood Plain Information reports and this study are due to the accuracy of the methods used.

Information used to prepare the FISs for Yamhill and Clackamas Counties and the Cities of Lyons, Salem, Keizer, and Hubbard (Reference 1,2,3,4,5, and 6, respectively) was used directly in this study. This study, therefore, agrees with those studies.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98021-9796.

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